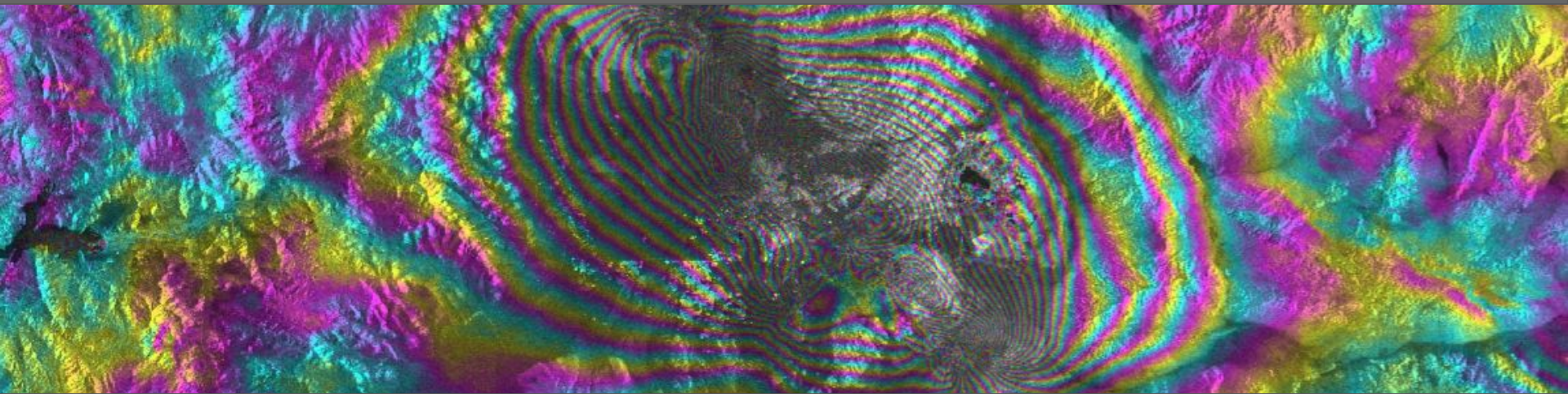


Accelerate your Science with On Demand InSAR Processing from ASF



NASA EOSDIS Webinar – July 28, 2021

Joseph H Kennedy, Senior RSE

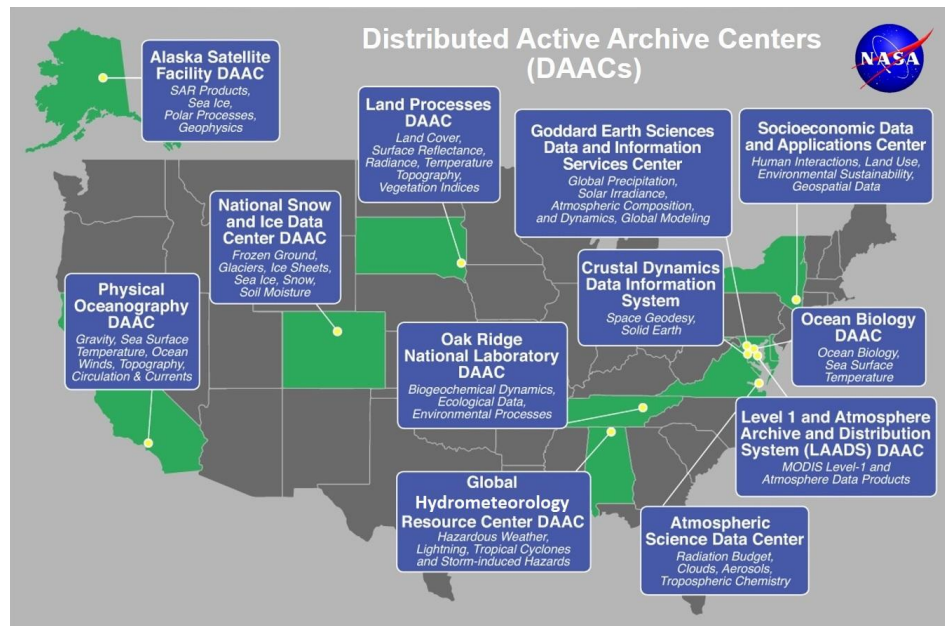
Alaska Satellite Facility



The Alaska Satellite Facility

Making remote-sensing data accessible

- EOSDIS Distributed Active Archive Center (DAAC)
- Acquire, process, archive, and distribute **Synthetic Aperture Radar (SAR) data** from polar orbiting satellites and airborne sensors
 - Data from NASA, ESA, JAXA, CSA
 - Easy to access and free to use
- Additional capabilities
 - Satellite tracking and ground station
 - SAR and Remote Sensing training/education
 - Science support



Why Synthetic Aperture Radar (SAR)?

Active microwave imaging

- Night or day
- Amplitude and phase
- Can penetrate clouds/dust

Suitable for interferometry

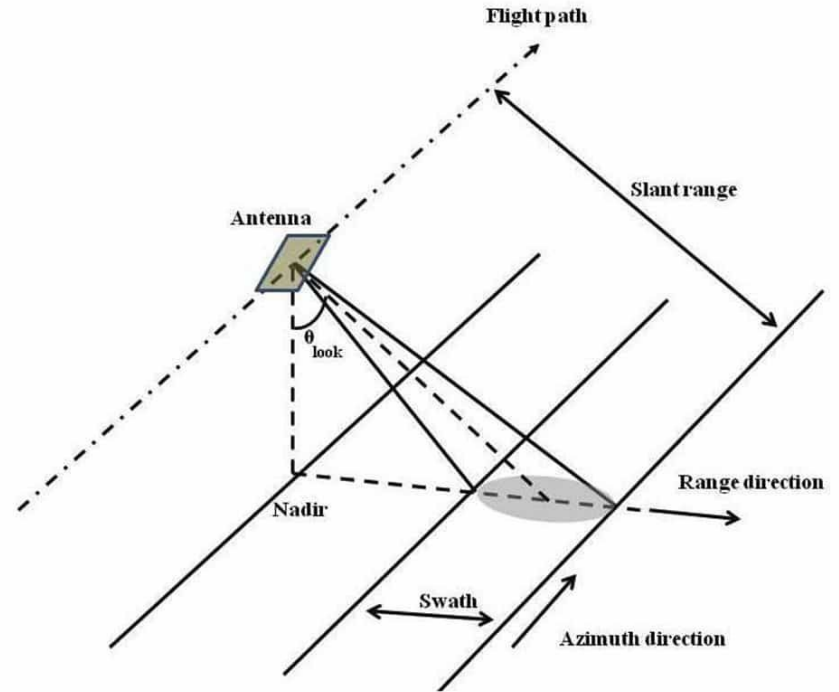


Image credit: NASA

What is InSAR?

Interferometric SAR

- Two SAR acquisitions over the same area
- Measure phase (2-way travel time)
- Interferogram is *difference* in phase
- Sentinel-1 is repeat-pass interferometry
 - Different position of satellite
 - Perpendicular Baseline
 - Different time of acquisition
 - Temporal Baseline
 - Best for *deformational* mapping

Vertex Tools

- **Baseline** -- helps you pick **pairs** for InSAR
- **SBAS** “Short Baseline Subset” -- helps you pick InSAR pair **stacks** for time-series analysis

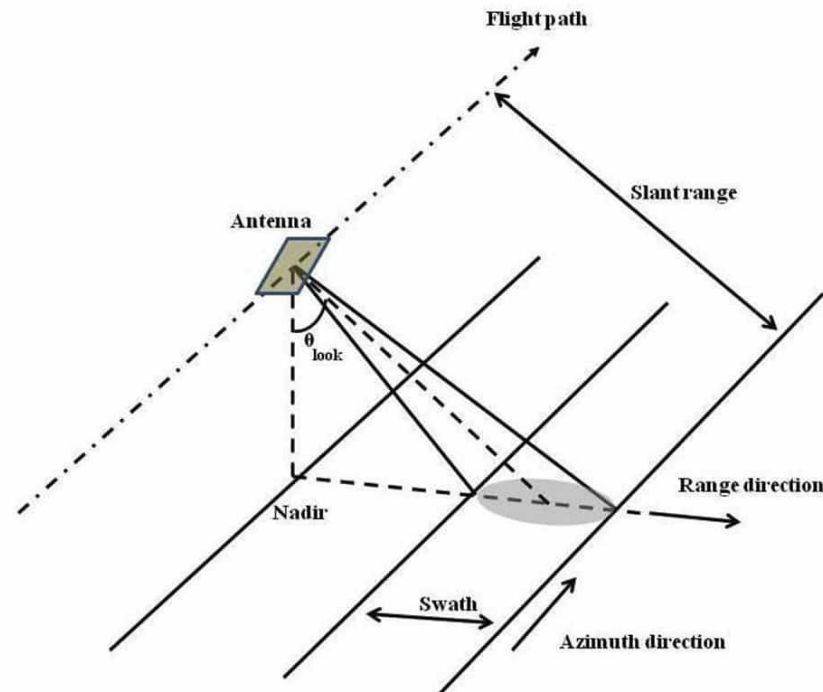


Image credit: NASA

Why Synthetic Aperture Radar (SAR)?

Active microwave imaging

- Night or day
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- Can penetrate clouds/dust

Suitable for interferometry

Robust platform for event/change monitoring

- Volcanoes
- Earthquakes
- Glacier movement

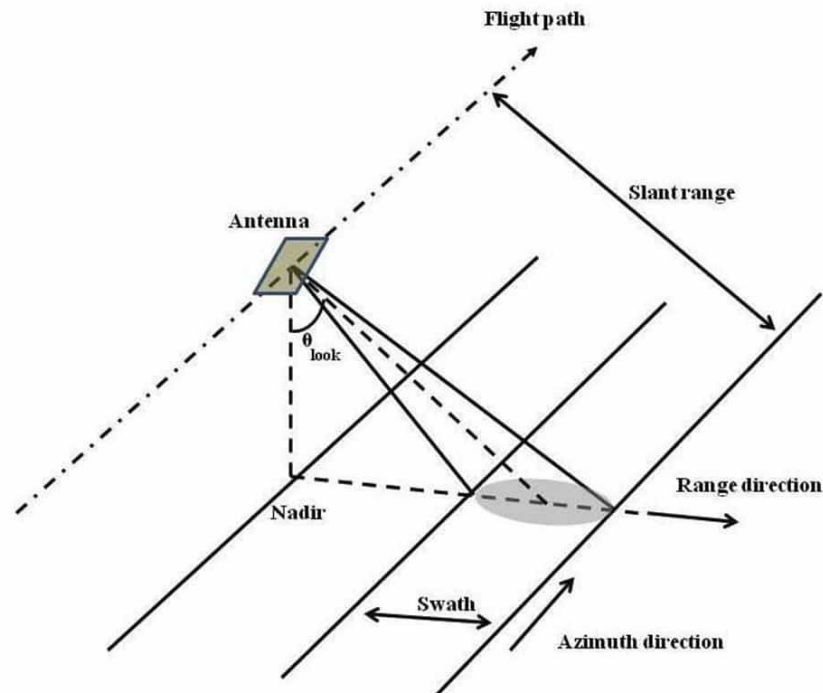


Image credit: NASA

Sentinel-1

European Space Agency mission

<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/overview>

- Two polar orbiting satellites (A and B)
 - 12 day repeat cycle
 - 180° orbital offset (same orbital plane)
 - Potential for 6-day repeat acquisitions
 - **Global coverage**
 - C-band imaging
- New data available *no more* than 3 days after acquisition
 - Typically < 24 hours!
- Free and easy to download from ASF in multiple formats
- On Demand processing to Analysis Ready Data available from ASF



Sentinel-1 Level 1 Data

SLC - Single Look Complex

- Single-looked and in slant-range geometry
 - Not GIS friendly
 - Image for each subswath (including overlap)
- Includes phase data
 - **Required for generating interferograms**
- Several images for each SLC
 - Retains each subswath (including overlap) and series of bursts, with a black line grid

GRD - Ground Range Detected

- Multi-looked and projected to ground-range
 - Easy to view/use in GIS applications
 - square pixels
 - small file sizes
- Phase data is lost
 - **Cannot generate interferograms**

Why *On Demand* SAR products?

- Complex data and processing
- Specialized software
- Resource-intensive
 - compute and memory
- Sheer volume of data available
 - Sentinel-1 has produced ~ 10 PB of data
 - Small area of interest may still result in thousands of scenes

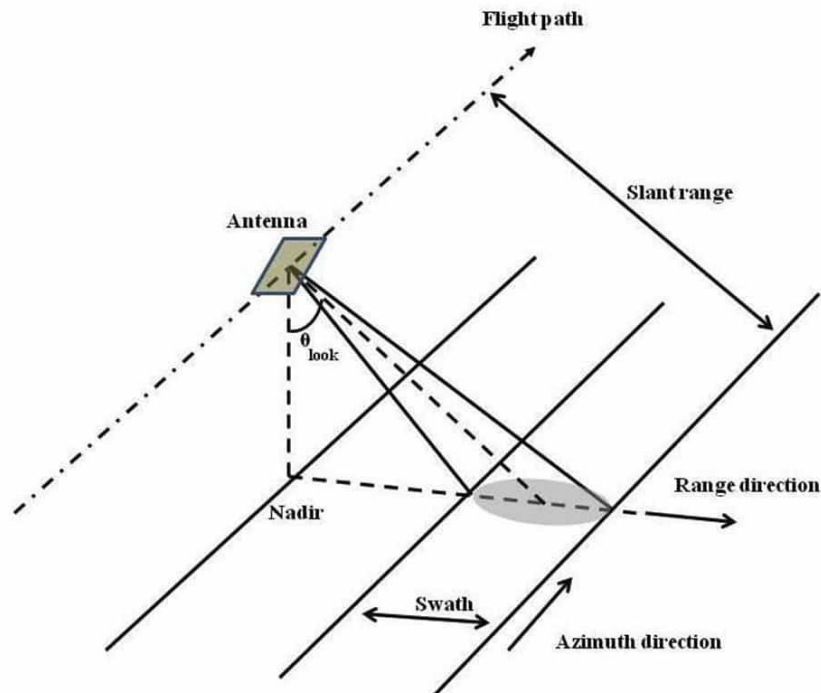


Image credit: NASA

Why *On Demand* SAR products?

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- Focus on **science** and **applications**!
- Process everything in parallel, in the cloud!



Image credit: [Maia Weinstock](#)

SAR Resources

NASA EOSDIS Webinars

- Introduction to SAR Data
<https://earthdata.adobeconnect.com/p21n0thk15bz/>
- Applications of SAR Data in GIS Environments
<https://earthdata.adobeconnect.com/potfhk9heoyk/>
- Sentinel-1 On-Demand RTC Processing
<https://earthdata.adobeconnect.com/pjddg6rvq2g2/>

EdX Alaska - *Free!* (Verified Certificate for \$199 USD)

- Synthetic Aperture Radar: Hazards
<https://www.edx.org/course/sar-hazards>
Next session starts September 7, 2021

The SAR Handbook

Comprehensive Methodologies for Forest Monitoring and Biomass Estimation

DOI: [10.25966/nr2c-s697](https://doi.org/10.25966/nr2c-s697)

Published April, 2019

Open Access!

Polarimetric Synthetic Aperture Radar

Principles and Application

Domains: Forest, agriculture, cryosphere, urban and oceans

DOI: [10.1007/978-3-030-56504-6](https://doi.org/10.1007/978-3-030-56504-6)

Published March 21, 2021

Open Access!

Example Use Case

2018 Kīlauea volcano eruption and collapse

- April 30, 2018 the summit of Pu'u'Ō'Ō collapsed
- Eruption continued through September
- Halema'uma'u crater
 - 280 feet (85m) → 1,600 feet (488m) deep
 - Diameter more than doubled
- 716 dwellings destroyed by lava
- ~30 miles of roads covered by lava
- ~1 billion cubic yards of lava erupted
- ~60,000 earthquakes April 30–August 4, 2016

More info:

<https://www.nps.gov/havo/learn/nature/2018-eruption.htm>



Ash cloud emanating from Pu'u 'Ō'Ō as its floor collapses, May 4th, 2018 (Photo: USGS)

Accessing Sentinel-1 Data

- Earthdata Login credentials
<https://urs.earthdata.nasa.gov/users/new>

- Accept the ASF EULA on Vertex
<https://search.asf.alaska.edu/>

Text available at: <https://asf.alaska.edu/uncategorized/eula/>

The screenshot shows the ASF Data Search Vertex web interface. At the top, there's a navigation bar with the NASA EarthData logo, a search bar, and various filters. The main content area is titled "EARTHDATA LOGIN" and includes a "Sign in" button highlighted with a red box. Below the login section, there's a message about the End User License Agreement (EULA) and a checkbox for notifications.

ASF Data Search Vertex

Search Type: Geographic | Dataset: Sentinel-1 | Area of Interest: WKT | Start Date: | End Date: | Filters: 250 of 13,659,511 Files

EARTHDATA LOGIN | My Profile | Sign Out

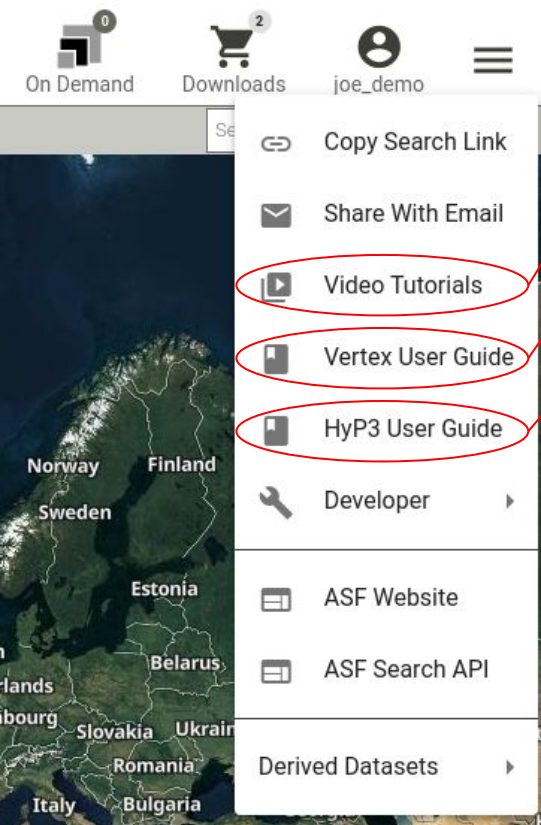
Alaska Satellite Facility: making remote-sensing data accessible

Application Administrators may send out occasional emails notifying users about application updates or alerts. ☒ Yes, I would like to be notified.

End User License Agreement

Please review the End User License Agreement below. You must agree to the terms and conditions in order to use the application.

On Demand Resources



Vertex On Demand Tutorial
<https://search.asf.alaska.edu/#/?topic=onDemand>

Vertex User Guide
<https://docs.asf.alaska.edu/>

HyP3 User Guide
<https://hyp3-docs.asf.alaska.edu/>

- Using -- Vertex, SDK, API
 - InSAR On Demand Story Map
<https://storymaps.arcgis.com/stories/68a8a3253900411185ae9eb6bb5283d3>
 - RTC On Demand Story Map
<https://storymaps.arcgis.com/stories/2ead3222d2294d1fae1d11d3f98d7c35>
- Product descriptions
- SAR Basics
- Other Tools
- What's New
- Contact Information

Vertex Baseline Demo

See our InSAR OnDemand Storymap: <https://storymaps.arcgis.com/stories/68a8a3253900411185ae9eb6bb5283d3>

Vertex SBAS Demo

See our InSAR OnDemand Storymap: <https://storymaps.arcgis.com/stories/68a8a3253900411185ae9eb6bb5283d3>

Handling Large Workflows Programmatically

asf_search Python package

https://github.com/asfadmin/Discovery-asf_search

- Basic search + download
- "Feels like" Vertex

HyP3 Python SDK

<https://github.com/ASFHyP3/hyp3-sdk>

- On Demand everything, and more!
- Easily build into workflows

On conda-forge and PyPI!

```
conda install -c conda-forge asf_search hyp3_sdk
```

```
python -m pip install asf_search hyp3_sdk
```

```
import os
import asf_search as asf

search_results = asf.geo_search(
    platform=asf.SENTINEL1,
    processingLevel=asf.SLC,
    beamMode=asf.IW,
    intersectsWith='POINT(-155.287 19.421)',
    start='2021-04-18',
    end='2021-05-12',
)

search_results.download('data/', token=os.environ['EDL_TOKEN'])

import hyp3_sdk as sdk
from hyp3_sdk.asf_search import get_nearest_neighbors

hyp3 = sdk.HyP3(prompt=True)

jobs = sdk.Batch()
for scene in search_results:
    neighbors = get_nearest_neighbors(scene.properties['sceneName'], max_neighbors=2)
    for neighbor in neighbors:
        jobs += hyp3.submit_insar_job(
            scene.properties['sceneName'], neighbor['granuleName'], name='hawaii-pairs'
        )
jobs = hyp3.watch(jobs)
jobs.download_files('data/')
```


Contacts and Resources



Follow NASA Earthdata for Earth science data, services and tools, news, and updates



<https://twitter.com/NASAEarthdata>

<https://www.facebook.com/NASAEarthdata>

Find data discovery and data access webinars, recipes and tutorials



www.youtube.com/c/NASAEarthdata

Have Data Questions? Try our Earthdata Forum
<https://forum.earthdata.nasa.gov>

Need Help? support@earthdata.nasa.gov



<https://www.asf.alaska.edu/>

ASF User Support

+1 907 474-5041

uso@asf.alaska.edu



<https://search.asf.alaska.edu/>

User Guide

<https://docs.asf.alaska.edu/>



<https://hyp3-docs.asf.alaska.edu/>

Follow us on Twitter: <https://twitter.com/ASFHyP3>

Chat with us: <https://gitter.im/ASFHyP3/community>

Find us on GitHub: <https://github.com/ASFHyP3>

Email me: jhkennedy@alaska.edu



On Demand InSAR
Joseph H Kennedy, Alaska Satellite Facility